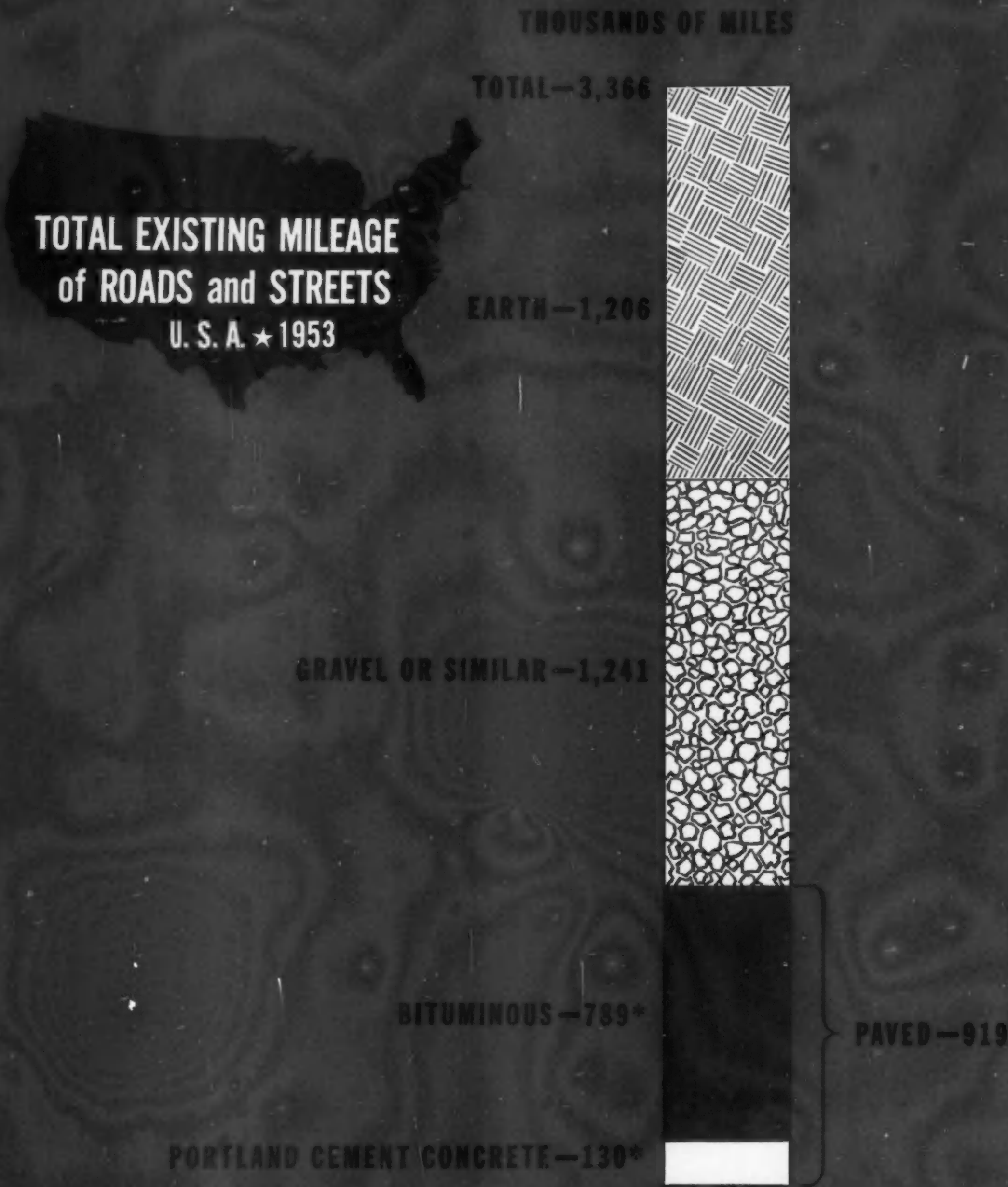
ASPHALT INSTITUTE Quarterly

APRIL, 1955



*NOTE: *Urban mileages included in these totals have been estimated by The Asphalt Institute and are based on previous spot checks.*

This chart reflects not only the established leadership of asphalt as a paving material but also points up strikingly the fact that *about 73%—or nearly 2½ million miles—of the U.S. road system is unpaved.* Although it is recognized that, by their location and lack of traffic, many miles of these roads and streets do not justify major improvement, there nevertheless exists a great potential for low-cost improvement as automobile production and the U.S. population increase.

Source: U. S. Bureau of Public Roads Figures

CHARTED BY THE ASPHALT INSTITUTE, APRIL, 1955

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The Member Companies of the Institute, who have made possible the publication of this magazine, are listed on page 15.

EDITOR

Richard C. Dresser

CONTENTS

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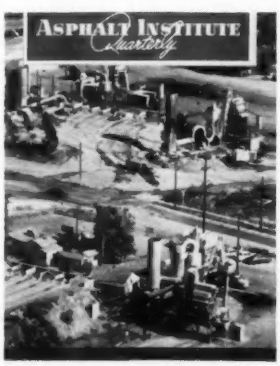


COVER

Grouped in a section of California's San Fernando Valley are fourteen asphalt plants, all either in operation or under construction. Plants belonging to Industrial Asphalt and to the Southwest Paving Company are pictured on the cover. It is equipment such as this which provides the asphalt mixes for the endless variety of paving and industrial uses of this versatile petroleum product.

Photo: Spence Air Photos

EDITORIAL

Through the ages man has constantly searched for better ways to use the natural resources of his planet. One of his primary activities in this respect has been the control and conservation of water.

Since earliest times, man has worked ceaselessly to capture his fresh water supply, to store it for future use. He has also constructed canals for transportation of his boats and ships and erected harbor breakwaters to safeguard his vessels against storm-tossed waters. On the coasts of seas and lakes and on the banks of rivers there has been an unending fight to hold back the waters bent on damaging or destroying fertile lands and homes.

Man's inventive mind has created new techniques to cope with the age-old problem of controlling and conserving water. The wells and crude irrigation ditches and dams of the past are being replaced with new forms. He has erected giant reservoirs and dams, networked deserts with irrigation canals, held back the encroachment of waters of seas, lakes and rivers with jetties, dikes, groins and levees. And yet all his work in the past several generations is but a child's step forward in his quest to make the best use of the world's water and also to put up the most effective defense against it. Witness the angry floods of 1953 in The Netherlands, the frequent seasonal storms on American shores which smash seaside houses into splinters and rip away the fine sand beaches, and the destructive floods which often sweep through the American midlands.

The development and effective maintenance of structures for the control and conservation of water has been a difficult and tedious job. Needed, of course has been a durable waterproof construction material, readily available at low cost and easily maintained, which could withstand the constant wearing action of water.

The one material combining all these qualities and characteristics is asphalt—long the leader in the road paving field. Although its use in hydraulic structures dates from earliest history, it has been only within comparatively recent years that, with the discovery and development of new techniques, engineers have come to realize that this versatile and remarkable petroleum product offered a practical solution to flood control, erosion and conservation problems. Engineers the world over are now using it in ever-increasing quantities in all types of hydraulic installations.

This issue of The Quarterly highlights some of the uses of asphalt in hydraulic structures throughout the world and serves to demonstrate that a vast field of activity awaits the imaginative engineer and contractor. As man moves forward, building structures to control and to store his water, the use of asphalt promises, by reason of its worth, to become exceedingly more widespread in the future.

Asphalt road on crest of this dike provided sufficient protection to prevent breaching during storm.

Workmen preparing and applying (in background) sand-asphalt course on dike slope. Wooden boards are then laid and compaction accomplished by tamping. Afterwards boards are removed and 4" course of asphaltic concrete is placed.

ASPHALT in Hydraulic Works in

By J. C. Jelgerhuis Swildens

The Asphalt Institute Quarterly is privileged to present this account—by the Director of the Vereniging voor Bitumineuze Werken, The Hague, Netherlands—of the Netherlands flood disaster of 1953 and of the part played by asphalt in the gigantic job of repairing the battered dikes.

ON THE night of January 31-February 1, 1953, one of the worst disasters in history struck the Netherlands. A severe gale, with winds often ranging to hurricane force, had blown a mass of water from the North Sea into the narrow funnel between the South of England and the Low Countries, piling it up in the estuaries and inlets of the provinces of Zeeland and South Holland. This, together with an abnormally high tide, brought about a combination of circumstances which proved to be fatal.

The water rose to levels far higher than had ever before been recorded. In numerous places the ocean swept over the dikes and scoured away the soft soil on the inland side. Attacked from both front and rear by their natural enemy, the dikes soon crumbled, and the ocean surged in, flooding the rich agricultural land. Nearly 1,800 people lost their lives. Tens of thousands of head of livestock perished.

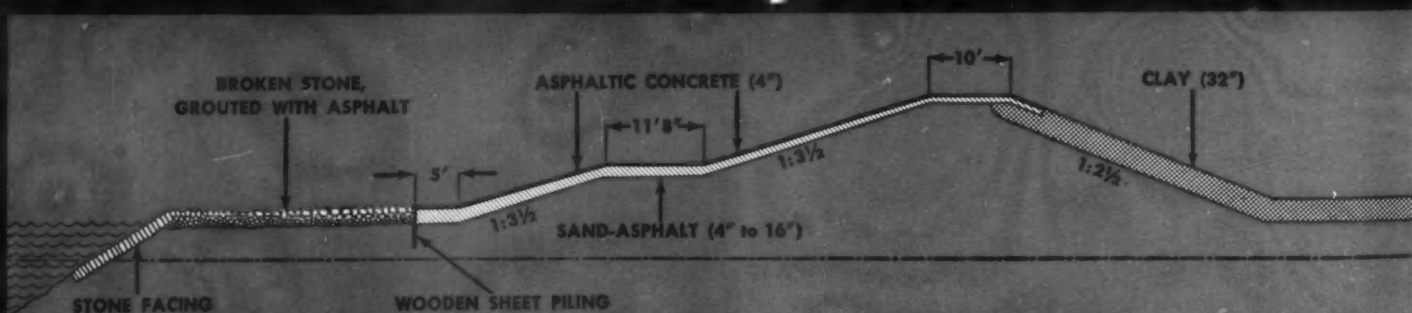
INITIAL REPAIRS

In the province of South-Holland the island of Goeree-Overflakkee was particularly hard-hit with respect to the length of dikes destroyed or badly damaged. Here some 28 miles of outer-dike and 40 miles of inner-dike required either complete renewal or extensive repair.

The Provincial Water Board and the "Rijkswaterstaat" (Government Water Board) tackled the work energetically, and by the middle of April, ten weeks after the disaster, the breaches were closed, the flooded area pumped dry, and a temporary outer-dike, extending just above normal tide, built around the island.

The principal problem, however, remained to be solved—the island still was not safe from the storms expected during the following winter. Only five or six months remained to renew completely 14 miles of outer-dike—an immense task which, it was feared, would be impossible to achieve.

The old, well-tried type of dike in Holland is built mainly of clay and protected only by stone and turf. For renewal



Cross-Section of Outer-Dike at Goeree-Overflakkee

Section of Goeree-Overflakkee dike, next to contractor's plant site, nearing completion.

Applying protective apron of asphalt on range of sand dunes near village of 's-Gravenzande.

of the outer-dike at Goeree-Overflakkee it was impossible to employ the orthodox method of dike-building since neither clay nor stone were available in sufficient quantities nor was there skilled labor available for stone setting. Above all, there was lack of time.

At several places in Holland macadam roads with light surface treatments have been built along the crest of the dikes. During the storm these thin asphalt coatings often were enough to prevent breaches in the dikes, as was the case near the town of Gouda, located almost in the heart of South-Holland. In building the dikes at Harlingen and the dams of the new naval harbor at Den Helder, asphalt had been employed, and these structures had also withstood satisfactorily the stormfloods of February 1. With this record of reliability of performance before them, the authorities decided to use asphalt in rebuilding the outer-dike at Goeree-Overflakkee.

CONSTRUCTION WITH SAND AND ASPHALT

To provide the enormous quantities of sand—about six million cubic yards—needed for the body of the dike, it was necessary to resort to the assistance of water—the very ocean water which had caused the floods. The mixture of water and sand, dredged from flats in the nearby inlets, was pumped through pipelines up to four miles long and deposited at the dike site. Grading the dike to correct profile was accomplished by bulldozers and drag lines.

The asphalt mixture, produced by plants erected at three strategic points on the island, was placed by the workmen

in THE NETHERLANDS

in two courses on the top and seaward side of the dike. The first layer consists of sand-asphalt and it varies in thickness from 4″ at the top to 16″ at the foot. After compaction by tamping with heavy tampers on wooden boards, the layer was sprayed with a thin coat of asphalt and then covered with crushed shells. The surface course of heavy-duty asphaltic concrete, uniformly 4″ thick from top to toe of the dike, was applied, where possible, by finishing machines, compacted by transverse rolling, and then sprayed with a coat of asphalt and covered with gravel chippings, pre-heated and rolled in. At the outer toe, the revetment rests on a piled planking approximately 8 feet in length and is protected by an apron of stone rubble grouted with asphalt.

As the new dike was constructed considerably higher than the old, the engineers felt that it would not be necessary to pave the inner slope. Sufficient clay remained from the old dike to enable placement of a layer of 32″, which was then covered with turf.

By means of this method of construction and the use of asphalt, and through the cooperative effort of the contractors concerned, the dike was completed before the winter storms and has since provided adequate protection in all respects.

OTHER REPAIR PROJECTS

Repair and construction with asphalt have also been carried out in other places in Holland. At another point on Goeree-Overflakkee, for example, and at the village of 's-Gravenzande, located on the mainland between Hook of Holland and The Hague, the storm had severely damaged the natural ranges of sand dunes.

On Goeree the "Rijkswaterstaat" decided to build a dike nearly 1.5 miles long behind the remnants of the dune range to aid its natural build-up and to provide added protection for the land to the rear. This dike was built with sand, taken from the range and the foreland, and provided with a protective coating of asphalt. At 's-Gravenzande, where a series of large concrete bunkers, built by the Germans during the war as part of their Atlantic Wall, formed part of the range, the engineers restored the damaged dunes by sand-filling and, on the seaside for a distance of 800 yards, supplied them with a protective sloping apron of hot-mix asphalt.

All the work and feats of hydraulic engineering involved in the closing of the innumerable breaches and tidal gaps resulting from the storm of February 1, 1953, would comprise an epic. In the projects described here, Dutch engineers found asphalt to be a valuable and useful material for protecting the structures upon which the very existence of Holland depends.

the Asphalt Groins at Ocean City Maryland

by R. K. Williams, Jr.
District Engineer
The Asphalt Institute

ON THE Atlantic Coast, some 130 miles from Baltimore, lies the town of Ocean City, Maryland. It is here that U. S. Route 50 begins to wind its way across the country to the Pacific, but it is not this fact for which Ocean City is noted. On the East Coast of the United States there are many fine resort beaches, and there are thousands of ocean bathers who will tell you that Ocean City has one of the best.

Over the years careful measures have been taken to protect this beautiful stretch of sand from the ravages of wind and ocean waves. To insure preservation of the beach, the State of Maryland, through its Roads Commission, began in the summer of 1954 to construct several groins between the Delaware State Line and the northern limits of the town of Ocean City, a distance of approximately seven miles.

Groins are long, solid structures which are built on a beach at right angles to the shore line. They are usually constructed from an inshore point either to the water's edge or into the water. Their function is to prevent beach erosion through their ability to "catch" sand, which the wind and waves build up around them.

SELECTION OF ASPHALT

For this type of structure asphalt is particularly suited because it can be placed quickly, easily and at low cost. Asphalt construction also costs little to maintain and has a notable record of long service life. After studying the currents, tides and littoral drift, the State Roads Commission decided to use hot plant-mixed sand asphalt in constructing the groins at Ocean City.

The engineers assigned to the project began by taking cross-sections of the beach at 450-foot intervals and discovered that for 100 feet inland the beach had a rise of 8% from mean low tide (zero elevation), then flattened to a grade of about 4% for the next 100 feet to its approximate inland edge. At this point, a sand fence, constructed some years ago, runs parallel to the surf line. The elevation of the sand dune created by this fence is more than 20 feet.

THE ASPHALT GROIN DESIGN

After a careful engineering survey of the situation, it was decided to locate the groins 950 feet apart and to construct them from the water's edge at mean low tide to the sand dune fence. Consequently, the groins are all approxi-

The famed bathing beach at Ocean City, Maryland.

mately 200 feet long. To keep excavation quantities to a minimum and to provide uniformity for the entire beach, a definite grade line was established and all groins were constructed to the same elevation. The engineers selected a 5% grade, starting at zero elevation and continuing to elevation 8.5 feet; from this point to the sand dune, the beach was flattened to zero grade.

The typical groin at Ocean City consists of two sections. The lower part—the apron—is 20 feet wide and varies in depth from 12″ at the water end to 4″ at the inshore end. The upper section, placed on the center of the apron, is 3 feet high, 8 feet wide at the base, and the top is rounded to a 1-foot radius. The sides have a straight slope and, where they join the apron, are rounded to a 1-foot radius. On the ocean end, the upper section height was decreased from 3 feet to 10 inches in the last 35 feet and was widened to 22 feet at the base.

INITIAL PREPARATIONS

Preparations for placement of the sand-asphalt constitute a very important phase of groin construction. Grading operations must be properly timed so that the first load of asphalt can be placed very shortly after low tide.

At the inshore end of the beach, about two hours before low tide, bulldozers would begin cutting the 30-foot-wide trench for the apron, grading the sand toward the water to build up a temporary dike around the ocean end of the excavation. The structure thus formed served for a short period as a protective barrier against the pounding surf and could stand only thirty to forty-five minutes before being destroyed by the rising tide. Thus all preparatory operations had to be carried out at a rapid pace to allow maximum time for placement of the sand-asphalt.

The form setters followed closely behind the bulldozers. Boards 2″ by 6″ were employed as side forms for the 20-foot apron, the top of the form being set to the finished grade of the apron. After some fine grading by hand, the workmen laid pierced steel mats on the sand, providing support for the asphalt trucks and enabling placement of the hot plant-mixed sand-asphalt in mass dumps, a very essential procedure when working where water is present.

MIX DESIGN

A mixture of 12% asphalt and 88% beach sand, heated to a temperature of 350°F. to 375°F., was placed at the ocean end of the apron. When the apron had been built up above the water level, the mix was changed to 8% asphalt and 92% beach sand and the temperature lowered to 300°F. For the upper section, the engineers selected a mixture of 92% beach sand and 8% asphalt heated to 200°F. A tack coat of rapid setting asphalt emulsion (RS-1), approximately, 0.3 gallon per square yard, was applied to insure a bond between the upper section and the apron. The asphalt cement used throughout was a 60-70 penetration grade.

PLANT OPERATION AND APRON CONSTRUCTION

A batch-type plant, erected adjacent to the coastal highway where there was an ample supply of dune sand available, produced the hot plant-mixed sand-asphalt. Sand was

Bulldozers cut trench for groin apron and build up temporary sand barrier for protection against surf.

Slip form, pulled by tractor, shapes asphalt upper section of groin centered on apron.

Placing the sand-asphalt apron. Note steel mats for support of truck.

These three views show how the asphalt groins "catch" sand and aid in beach buildup. *Photos: Maryland State Roads Commission*

fed to the cold feed bins by a clam-shell, while tank trucks supplied the asphalt cement to the plant.

Because the bottom of the apron was located 1 foot below zero elevation, water was always present during construction of the first 20 feet. As pumps proved unsuccessful in keeping the area dry, it was necessary to have enough of the asphalt mixture available at the site to insure continuous operation until the apron was brought out of the water. Dumping the loads into the water had to be done quickly so that the hot asphalt would retain heat long enough to form a homogeneous mass. If the asphalt mix was allowed to cool between loads, layers would form which would break off under the surf action. Thus the mix was deposited as close to the end form as possible and as quickly as the trucks could back down the mat runway.

The material was moved into final position by use of hand shovels and then leveled by rakes. The steel mats were removed as construction progressed. After completion, the apron was allowed to cool from 36 to 48 hours before construction of the upper section was begun.

CONSTRUCTION OF THE ASPHALT UPPER SECTION

Before starting to build the upper section of the groin, it was necessary to remove the sand from the apron, which sometimes accumulated to a depth of several feet. A bulldozer was used for this operation, and here again, as in the excavating operations, it pushed the sand to the ocean end to form a temporary dike. After a final cleaning with hand-brooms, the light tack coat of rapid setting emulsified asphalt was applied and a slip form placed at the ocean end. Trucks dumped the hot-mix sand-asphalt directly into the slip form, which a tractor then pulled up the grade. Some hand work was required to bring the groin to final shape and grade. Light tamping provided final compaction.

GROINS BUILD THE BEACH

Between August and December, 1954, 33 of these asphalt groins were constructed at Ocean City. Recent reports reveal that some of them are completely covered with sand and have disappeared from view. This means that the beach has built up several feet and has widened considerably—exactly the result intended. This excellent work is a tribute to all those concerned with the project and attests to the rapidity and economy of low-cost asphalt construction.

The Fernandina Beach Groins

By Dillard D. Woodson,
District Engineer, The Asphalt Institute

During the months of November and December, 1953, eight asphalt groins of a design similar to those built at Ocean City were constructed at Fernandina Beach, Florida, located in the extreme northeast tip of the state. Here, however, the engineers decided to place wooden pilings within the groins and to build up the asphalt around them. This preliminary work was begun in the late summer of 1953.

The mixture selected consists of local dune sand and 7% asphalt of 50-60 penetration. The structures are approximately 4 feet in height, 1½ feet wide at the top and 10 feet wide at the base. The slope of the face of the groins is about 1 to 1.

Now slightly over a year old, the groins, according to the City Engineer at Fernandina Beach, are doing a fine job in building up the beach, which had become rather badly eroded along its northern end. He stated that additional structures would be built as soon as funds became available. Just eighteen working days were required for the asphalt construction employed in the existing eight groins.

Photo Steve Barrett

View of Garvey Reservoir on August 14, 1956, shows completed asphalt lining and portions of lining for drainage ditches.

Paving Los Angeles' Garvey Reservoir with Heavy-Duty Asphalt

by Phillip L. Bailey and Louis R. Hovater

WHILE man fights the devastating action of water as it works to break down his dikes and wash away his beaches on the seacoasts of the world, elsewhere he is putting this indispensable liquid to beneficial use. Since earliest times man has sought water to drink, to irrigate his land, to supply power for his machines; its use for these and other purposes is basic to the welfare and economy of civilization. Indeed, the presence of water on earth is essential to man's survival, for his own body demands substantial quantities of it and this demand must be fulfilled.

ADEQUATE STORAGE REQUIRED

In the modern world, with its concentrations of immense populations in and near cities, the provision of adequate storage space for water is a primary necessity. Because natural bodies of water such as rivers and lakes usually do not constitute an adequate source for many great urban areas, engineers have been required to construct additional facilities for capturing and conserving water which would otherwise be wasted in runoff.

One of the most recent of these conservation facilities to be built is the Garvey Reservoir, excavated out of the hills of Monterey Park, near downtown Los Angeles. Measuring 2,000 by 1,000 feet, with a depth of 60 feet, this great storage bowl has a 3″-thick pervious surface lining of asphaltic concrete placed on an impervious blanket of select material compacted with specially designed 30,000-lb. rollers and varying in thickness from 10 feet at the bottom to 3 feet at the top of the slopes.

The use of asphalt in reservoir construction is by no means new. Engineers have employed it in California and in other parts of the country in nearly all types of hydraulic installations for many years. The inherent characteristics of asphalt —its versatility, flexibility and rugged durability—make it the ideal material for lining these structures which must be built to withstand the continual abuse inflicted upon them by nature's elements.

NEW TECHNIQUE SPEEDS WORK

For laying the asphaltic concrete lining in the Garvey Reservoir, the contractor developed a new technique which made possible the use of a mechanical spreader on the 3:1 slopes. By this method placement of the asphalt mix averaged 600 tons per day, enabling completion of the project months ahead of schedule. The quality of the work also was better than could have been achieved by placing the mix with the conventional spreader box.

The contractor built a ramp at the crest of the reservoir to which was attached a tractor with equipment for hoisting the mechanical spreader up the slopes. The rockers on the ramp were so designed that the ramp tracks would tilt forward when the rear of the spreader passed the crestline of the reservoir, lifting the ramp and spreader just enough to permit the tractor and attached ramp to be moved into a new position. Then, when the spreader was backed down the ramp to start placement of the next course of asphaltic concrete, the rockers tilted backward, and the spreader again was on the slope.

Three hoists were required for the paving operation—one for the trucks feeding the spreader, one for pulling the spreader up the slope, and one for the $4\frac{1}{2}$-ton roller used for final compaction of the course. For those areas on the slopes inaccessible to the mechanical spreader and $4\frac{1}{2}$-ton roller, the asphalt mix was spread by hand and compacted with a small hand roller. On the reservoir bottom, final compaction was obtained by using an 8-ton roller.

POROUS LINING PROVIDED

The asphaltic concrete mix consists of a 60-70 penetration asphalt and a specially graded aggregate to provide porosity. Such a porous lining relieves back pressures and prevents upheaval of the pavement on drawdowns of water level. Water in the bank storage thus is allowed to seep back into the reservoir.

The reservoir lining covers 974,000 square feet on the reservoir bottom and 865,000 square feet on the slopes. Asphalt pavement was also placed on access roads, parking areas and drainage ditches around the reservoir, making this truly an all-asphalt project and providing an excellent example of the versatility of this wonder product.

Spreader is lowered down slope in preparation for placement of another width of asphalt lining while $4\frac{1}{2}$-ton roller supplies compaction near reservoir crest.

Spreader has completed run to top of slope and here rests on special ramp attached to tractor. When moved to next position on crest, spreader backs off ramp and down slope.

Hand roller compacts the lining near crest. Reservoir measures 2000 x 1000 ft. x 60 ft. deep, has over 96,000 sq. yds. of heavy-duty asphalt lining.

Prefabricated Asphalt Lining in Colorado Reservoir Reduces Water Seepage

Photo: Stewart's, Colorado Springs

The reservoir supplying water to Colorado's Broadmoor Hotel holds over 20,600,000 gallons. Prefabricated asphalt lining on reservoir bottom reduces loss of water from seepage.

by John R. Banning,
District Engineer, The Asphalt Institute

For centuries hydraulic engineers have been confronted with the problem of controlling the seepage of water through such permeable earthen structures as dams, canals, and reservoirs. Until a comparatively few years ago no economical method was known by which loss of water in this manner could adequately and positively be prevented. The development of various types of asphaltic linings, however, has changed this situation. Today engineers are familiar with these tough, durable, waterproof and low cost linings and they are now using them widely for controlling seepage in hydraulic installations.

The reservoir which supplies the Broadmoor Hotel, the well known Colorado resort haven and community near Colorado Springs, is a case in point. The Hotel is located at the base of 9,407-foot Cheyenne Mountain and gets its water from a number of sources situated high on the adjacent slopes. In 1928, to provide more water storage and to equalize pressures, the Broadmoor Hotel Water and Power Company elected to build the Fisher Cañon Dam, 600 by 400 by 30 feet deep. The site chosen was of sufficient elevation to insure impounding 20 million gallons of water and provide adequate hydraulic gradient for the then proposed power and distribution systems.

Test holes were dug and findings indicated that impervious material could be obtained in sufficient quantities to construct an impervious core in the dam and to line the bottom of the reservoir. This material, however, "pinched" out before the project could be completed, requiring the engineers to finish the job with the materials that remained—boulders and disintegrated granite gravel. Rock rip-rap was placed on the face of the dam and cut slopes.

WATER LOST THROUGH SEEPAGE

The result was that over the years the reservoir lost tremendous amounts of water through seepage, a situation which caused grave concern among officials and engineers of the Broadmoor Company. Various attempts were made to correct the condition by cement grouting, cutting out weak areas and placing portland cement concrete, and mixing bentonite into the gravel bottom, but all ended in failure.

In the spring of 1954, after a complete new survey was made and upon recommendations by The Asphalt Institute and a consulting engineer, it was decided to lay plank-type prefabricated asphalt lining on the bottom of the Broadmoor Reservoir.

Prefabricated linings consist usually of matted fibres of asbestos, rag or other similar material saturated and coated with asphalt. They are manufactured in sheets and, depending on the nature of the installation and thickness required, are shipped from the factory either flat or in rolls. They are laid by hand and are used not only in reservoirs but also in canals and irrigation ditches.

PLACEMENT OF ASPHALT LINING

The bottom of the Broadmoor Reservoir was shaped up with a motor patrol and rolled with an 8-10 ton tandem roller. After hand-spreading Polybar-Chlorate as a herbicide to prevent possible vegetable growth, workmen placed the prefabricated sheets, lapping each sheet three inches on all sides.

Before application of the hot joint adhesive, it was necessary to broom off the waste rice hulls which had been dusted onto each sheet to prevent sticking during transit from the factory. Workmen then mopped the adhesive on the joints, which were later repainted to insure watertightness. Using a rapid method of installation developed by the contractor, eight men were able to install the lining at the average rate of 1,000 square yards per day.

Until this lining was installed, the Broadmoor Reservoir was unable to hold water for any appreciable time after the intake supply was turned off. Thanks to low-cost asphalt construction, it now has adequate protection against the seepage which had formerly caused so much valuable water to go to waste.

DAM FACINGS

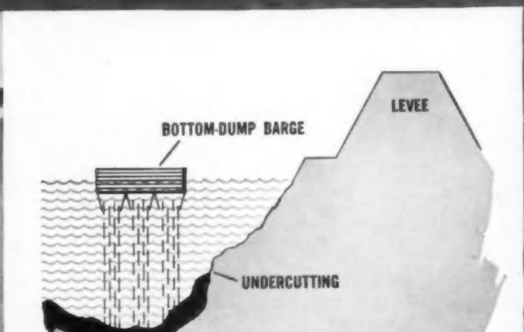
California's beautiful Glen Anne Dam, near Santa Barbara, has a 12"-thick protective pavement of waterproof, durable asphalt, applied in 1952.

Rugged, Versatile **ASPHALT** has many uses in Water Control and Conservation

RIVER BANK PAVING

Asphalt pavements on river banks prevent undercutting and scour by high velocity and turbulent water. Here hot-mix asphalt is being applied on bank of Mississippi River as protection for its great levee system.

Hot sand-asphalt mixtures dumped on river bottom from barges check undercutting of bank by swift currents.



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CHANNEL LININGS

Heavy-duty asphaltic concrete lining in a Los Angeles County storm channel. In smaller channels prefabricated asphalt plank linings have widespread use.

JETTIES

The famed Jetty at Galveston, Texas, a solid structure built of stone and a sand-asphalt mixture in 1935, has given top service for 20 years despite heavy pounding by Gulf storms.

SEA WALLS

The sea wall at Edisto Beach, South Carolina, built of hot-mix sand-asphalt in 1951, has effectively resisted erosion while protecting from storms valuable shore property at rear of beach.

CANAL LININGS

Asphalt canal linings prevent loss of water from seepage, protect banks from erosion, lessen hydraulic friction, and reduce maintenance. Here asphalt lines a canal at Sunnyside, Washington.

Special lining machine places asphaltic mixture in canal near Pasco, Washington.

Photo: U.S. Bureau of Reclamation

There are many different types of asphaltic canal linings. Asphalt is also employed in the construction of swimming pools. For details and further information, contact any Asphalt Institute office (see next page).

Asphalt Institute Engineers

GEORGE H. DENT
Assistant Chief Engineer

RALEIGH W. GAMBLE
District Engineer at Chicago

ASSOCIATED with The Asphalt Institute for fourteen years, first as District and later as Division Engineer, George H. Dent has been promoted to the newly-created position of Assistant Chief Engineer at the Institute's headquarters office in College Park, Maryland.

Mr. Dent takes over his new job with a noteworthy record of devoted service and long experience in the highway paving field. An alumnus of the University of Maryland, he has served with the Maryland Roads Commission successively as Materials Engineer and Bituminous Engineer and with the Civil Aeronautics Administration as Paving Engineer. As an Institute Division Engineer, he directed asphalt engineering and educational activities in the Atlantic-Gulf area from his office in Washington, D. C.

Mr. Dent is President of the Association of Asphalt Paving Technologists and holds memberships in the National Society of Professional Engineers, and the Engineering Clubs of Baltimore and Washington.

AS DISTRICT ENGINEER with offices at 11 South LaSalle Street, Chicago, Raleigh W. Gamble extends Institute engineering facilities for the promotion of asphalt throughout Illinois and Wisconsin.

Mr. Gamble joined The Asphalt Institute after thirty years as Superintendent of the Bureau of Street Construction and Repairs of the City of Milwaukee. During this period, when over 16,000,000 square yards of pavement of various types were built and 1,500 miles of streets kept in repair, one of his outstanding contributions was the planning, promotion, construction and administration of Milwaukee's expressways. During his last four years in that City he also held the post of Director of Expressways.

Mr. Gamble is a member of the American Society of Civil Engineers, the American Road Builders Association, the Highway Research Board, the Wisconsin Society of Professional Engineers, the University of Wisconsin Cooperative Committee, and the Engineering Society of Milwaukee.

ENGINEERING OFFICES AND DISTRICTS

New York 20, N. Y.—1270 Avenue of the Americas
New York City, Long Island and New Jersey

Boston 16, Massachusetts—419 Boylston Street
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Albany 3, New York—45 North Lake Avenue
New York State (except New York City and Long Island)

Harrisburg, Pennsylvania—904 North Second Street
Pennsylvania

Richmond 19, Virginia—Travelers Building
Delaware, District of Columbia, Maryland, North Carolina, Virginia

Atlanta 3, Georgia—Mortgage Guarantee Building
Alabama, Florida, Georgia, South Carolina, Tennessee

New Orleans 16, Louisiana—1531 Henry Clay Avenue
Louisiana, Mississippi

Columbus 15, Ohio—Neil House
Indiana, Kentucky, Michigan, Ohio, West Virginia

Indianapolis 20, Indiana—5440 Central Avenue
Indiana, Southern Michigan, Northern Kentucky

St. Paul 4W, Minnesota—Midway Building
Iowa, Minnesota, North Dakota, South Dakota

Chicago 3, Illinois—11 South LaSalle Street
Illinois, Wisconsin

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